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Reduction of Hexavalent Chromium in Ground Water by Adding Hydrogen Peroxide and Adjusting pH

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Ground water containing volatile organic compounds (VOCs) and hexavalent chromium is being treated at a facility located in the central-western portion of the Lawrence Livermore National Laboratory Livermore Site. Ground water treatment is required because VOCs, primarily trichloroethylene, occur at concentrations exceeding maximum contaminant levels (MCLs). Ground water is extracted, and most VOCs are destroyed by exposing ground water to ultraviolet light (UV) in combination with hydrogen peroxide (H_2O_2). The residual VOCs are removed by air stripping.

Although hexavalent chromium concentrations do not exceed MCLs, naturally occurring concentrations at 25 parts per billion (ppb) do exceed regulatory discharge limits. in the past, hexavalent chromium in ground water was removed by passing it through ion-exchange resin columns. The capital cost of this process is comparatively high, and regenerating the columns involves production, handling and disposal of hazardous waste. A series of benchtop tests were conducted to find an alternative method for the ion-exchange resin columns. These tests indicated that hexavalent chromium can be reduced by a combination of: 1) lowering the ground water pH to 7 or less, 2) adding H_2O_2 to reach concentrations of 20 parts per million (ppm) in the ground water, and 3) allowing at least 20 minutes of reaction time.

After the success of the benchtop tests, the existing treatment facility was modified to accommodate this new treatment. After the ground water passes through the UV/ H_2O_2 system, the pH is reduced by injecting carbon dioxide. The ground water then passes through a 5,000-gallon tank to allow sufficient reaction time. We found that this process reduced initial hexavalent chromium concentrations of 25 ppb to 10 ppb, which is well below the 22 ppb discharge limit.

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